

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[EIGHTH SERIES.]

No. 15. MARCH 1909.

XXVII.—*Notes on Larval Trematodes* *. By WILLIAM NICOLL, M.A., D.Sc., and WILLIAM SMALL, M.A., Gatty Marine Laboratory, University of St. Andrews.

DURING a short visit to the West of Scotland Marine Biological Station at Millport in August 1908, we had occasion to examine a few of the commoner Crustaceans and Molluscs. One object in doing so was to obtain a general idea of the larval Trematode forms to be met with in the Clyde area, and in particular to investigate the occurrence of cercariæ in the common edible and green crabs. The time at our disposal was not sufficient to permit of much material being examined, so that the number of larval forms to be described is small, but in the case of the crabs our efforts were more successful.

In addition to *Cancer pagurus* and *Carcinus mœnas*, a few specimens were examined of each of *Eupagurus bernhardus*, *Portunus depurator*, *Crangon vulgaris*, *Balanus balanoides*, *Venus cassina*, *Mytilus edulis*, *Aporrhais pes-pelecani*, *Patella vulgata*, and *Lima hians*. Only the last-mentioned harboured cercariæ. A few young fish, *e. g.* plaice, dabs, and bullheads, were also examined and in two of these encysted cercariæ were found.

* [This work has in part been done with the aid of a Government Scientific Research Grant.—W. N.]

Cercaria excellens, nov.

This was found encysted in large numbers in *Carcinus mœnas*, and less frequently in *Cancer pagurus*. It is undoubtedly the larva of some species of the genus *Spelotrema*, and, as will be shown later, the adult species to which it can most probably be referred is *Sp. excellens*, Nicoll.

Three out of every four green crabs were infected; in the case of the edible crab the infection was not more than one in five. At St. Andrews we have found the infection somewhat greater; every green crab examined there contained the cercariæ in greater or less numbers, while about 25 per cent. of the edible crabs were infected. In the green crab the number of cercariæ is frequently enormous, every organ and tissue in the crab's body being riddled with cysts, so much so that sometimes one would think that the mass of cysts was actually greater than the organ in which they are contained. The chief seat of infection is the liver and next to that the gonads, but no structure is immune, except the calcareous parts. The cysts are occasionally found throughout the muscles and along the course of the nerves, blood-vessels, or alimentary canal. They may occur either singly or in clusters, bound to each other by the fibrous tissue in which they are embedded.

These observations agree with those of M'Intosh*, who forty years ago found the crabs at St. Andrews infected to the same extent with cercariæ. Whether the cercariæ which he described then are the same as those we have met with is a matter of doubt, but this will be referred to again later.

When extricated from their fibrous investment the cysts are seen to be globular in shape. In some cases they appear to be very slightly ovoid, but this is probably due to pressure in freeing them, and usually they can be made to assume the globular shape by suitable manipulation. At first we were inclined to believe that two different kinds of cysts were present, for many were obviously, even to the naked eye, much smaller than the others. Under the microscope the difference was further accentuated by the fact that the wall of the smaller cysts was proportionately much thinner than that of the large cysts. On more exhaustive examination, however, what may be interpreted as intermediate forms were discovered, midway in size between the large and small forms. In point of numbers the large cysts far exceeded the small and intermediate-sized cysts.

In a series of measurements of about 30 cysts, two-thirds

* Quart. J. Micr. Soc. vol. v. (1865) p. 201, pl. viii.

were found to have a diameter between .43 mm. and .49 mm. In these the thickness of the outer wall was .027-.054 mm., average .036 mm.; and the thickness of the inner wall .008-.023 mm., average .017 mm. Thus the outer wall is two or three times as thick as the inner, but in one or two cases the ratio was not more than 3 : 2. Only in a few cases was the cercaria expressed from the cyst in an undamaged condition. The approximate length of the cercaria was found to be .8-1.0 mm. In every case the oral sucker was larger than the ventral, the diameter being .066-.03 mm. for the oral and .06-.068 mm. for the ventral. In some cases the genital sucker was also measured and found to have an average diameter of .052 mm.

Of the remaining cysts a group of four measured .36-.39 mm., average .37 mm. In these the outer wall had a mean thickness of .015 mm. and the inner .006 mm. In only one case was the cercaria obtained in an undamaged state and its length was .7 mm. No difference in size could be detected between the oral and ventral suckers, each measuring .054 mm., while the genital body measured .048 mm.

A third group of five much smaller cysts measured .27-.32 mm., average .305 mm. The outer and inner walls were .011 mm. and .007 mm. thick respectively. None of the cercariæ from these were examined. From these figures there seems no reason to suppose that these groups are other than stages in the growth of the same cyst, and such being the case it is evident that the cercariæ increase considerably in size during their sojourn in the crab. The only alternative is that they represent the larvæ of three different adult species. It is unfortunate that more detailed examination of the smaller cercariæ was found impossible, as that might have been of help in deciding the matter.

A fourth variety of cyst was met with, but only on one or two occasions. It was about the same size as the foregoing, but differed in having a cell-wall composed of only one very thin (.002 mm.) layer. In none of these was the cercaria examined. They must apparently belong to a distinct species, unless, indeed, they are abnormalities. A possibility which might be suggested is that they are just some of the ordinary cysts in which the outer layer has been accidentally stripped off; but there was no evidence of this and in addition the thickness of the wall is much less than that of the inner layer even in the smallest of the cysts.

A detailed description of the anatomy of the cercaria is not necessary here, as it agrees well with that of the adult,

due allowance being made for the stage of development. The dimensions of the chief organs have already been given. The ventral sucker is situated at the beginning of the posterior third of the body length. The genital sucker lies close to its left side. The intestinal diverticula terminate at the level of the centre of the ventral sucker. The testes lie close behind that sucker, one on each side, but the yolk-glands are not visible. In most cases the ovary can be made out on the right side of the ventral sucker, and in some the vesicula seminalis in front of the sucker.

As already mentioned, this cercaria is probably the larva of a *Spelotrema* species. The only other genus which might come into question is *Levinseniella*, but the character of the genital sucker points rather to *Spelotrema*. Of the species of the latter genus the only one which can be considered is *Spel. excellens*, Nicoll, the large size of the cercaria excluding the possibility of its identification with any of the other species of the genus.

The adult *Spelotrema excellens* is found in great abundance in the herring-gull (*Larus argentatus*), both at St. Andrews and Millport. *Spelotrema simile*, Jägersk., the next largest *Spelotrema* species, is much rarer.

With regard to the cercaria described by M'Intosh *, it is unfortunate that he gives no exact measurements either of the cysts or of the cercariæ. By measurement of his figures (pl. viii.), which are magnified 180 diameters, we find that the cyst in fig. 1 had a diameter of .14 mm., and that in fig. 2, .17 mm. The cercaria in fig. 5 is exactly .5 mm. long. It requires but a glance at the plate to see that the cercaria in fig. 5 is much too large to have come from a cyst of the size shown in figs. 1 and 2. By the kindness of Professor M'Intosh a tube containing some of his original material from *Carcinus maenas* was placed at our disposal, but in it only one cyst was found. The diameter of this was .29 mm.; the outer radially-striated wall was .01 mm. thick and the inner concentrically striated .012 mm. From these somewhat meagre details we are forced to the conclusion that Professor M'Intosh also had a variety of cysts under his observation, some of which correspond in size with those which we have found, but others being much smaller. The only other explanation is that some error has crept into his estimation of the magnification. It is hardly to be believed that the character of the infection of the crabs at St. Andrews has undergone a change from small cysts to large ones during the space of forty years.

* *Loc. cit.*

A point of interest is that M'Intosh apparently met with some of the single-walled cysts already referred to, for he says (p. 202) that the wall of the cysts "consists of two layers marked by minute striæ and specks; but the outer cannot always be seen."

Reference may here be made to Miss Lebour's investigations* of larval Trematodes in *Carcinus mænas* from the Northumberland coast. Her results appear to differ entirely from ours, for although she found the crabs fairly well infected, the cysts were of quite a different character, being single-walled and oval. The cercariæ in these cysts are apparently of the *Spelotrema* type. Their identity is doubtful, but it seems certain, at least, that they are not the same as the cercariæ we have just described. Miss Lebour, however, found a single specimen of another cyst in the crab. This was smaller than the others, spherical and double-walled. The cercaria was not examined, but from the size and character of the cyst it was presumed to be probably the same as M'Intosh had found. Whether this be the case or not it is curious that these double-walled cysts should be so rare in the Northumberland crabs in contrast to their great abundance at St. Andrews. It may possibly be regarded as an instance of the peculiar effect which local conditions may exert even on the parasitic fauna.

It may not be out of place to mention here another cercaria found by Miss Lebour † in *Balanus balanoides* and referred with much doubt to *Spelotrema excellens* as the adult. The size (1 mm.) of the cercaria is suggestive of *Spel. excellens*, but the configuration of the alimentary canal differs considerably from that in *Spel. excellens* and bears much more resemblance to that of *Levinseniella brachysoma* (Crepl.).

Cercaria lima, nov.

Five specimens of *Lima hians* were examined and in two of them a single cyst was found. In both cases it was loosely attached to the inner side of the mantle-edge, projecting into the mantle-cavity.

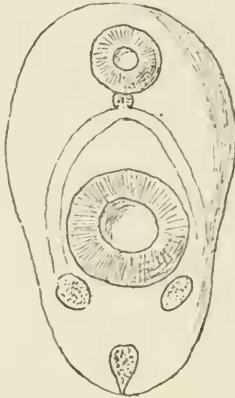
The cysts are spherical, about .3 mm. in diameter and have a thin, opaque, membranous wall. The liberated cercaria is .6 mm. long and of somewhat elongated oval outline. It is colourless and very transparent, so that little of its internal anatomy could be made out. The suckers are both globular,

* "Trematodes of the Northumberland Coast: II.," p. 10, pl. i. figs. 8, 9, in Trans. Nat. Hist. Soc. Northumberland, New Series, ii. part i.

† *Loc. cit.* pl. i. figs. 6, 7.

the oral having a diameter of $\cdot 120$ mm. and the ventral $\cdot 152$ mm.; the latter is situated at the beginning of the posterior third of the body. The cuticle is smooth and without spines. Just behind the ventral sucker two small oval testes are placed, one on each side, with their long axes directed obliquely outwards and forwards. The ovary could

Fig. 1.

*Cercaria lima.*

not be distinguished, being probably concealed by the ventral sucker. A short excretory vesicle lies at the posterior end of the body. There is a small pharynx contiguous with the oral sucker; two simple intestinal diverticula arise immediately behind the pharynx and appear to terminate near the testes.

This is apparently the first record of this cercaria, and no other entozoa have hitherto been described from *Lima hians*.

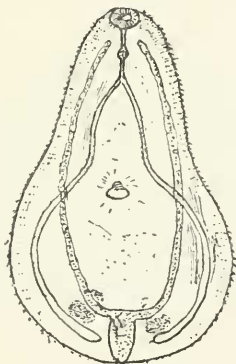
Even with the scanty details given above, it is not difficult to recognize in this cercaria the larva of a species belonging to one or other of the genera *Steringophorus* or *Fellodistomum*. The position of the suckers, their large size and particularly the prominence of the ventral sucker, the situation of the testes, and the smooth condition of the cuticle all support such an identification. The characters of the excretory vesicle and the alimentary system are also of importance. Moreover, these are the only two genera of British Trematodes with which the cercaria shows any affinity. More detailed differentiation seems at present out of the question. The small excretory vesicle without conspicuous lateral stems and

the absence of œsophagus (although this may be due to contraction) are strong evidences in favour of *Fellodistomum fellis* (Olss.) being the adult; the only contra-indication to which is the fact that *Anarrhichas lupus*, the only known host of *Fellodistomum fellis*, is not common in the neighbourhood of Millport.

Cercaria concava, nov.

In a young plaice (*Pleuronectes platessa*), about $4\frac{1}{2}$ inches long, a small round cyst was found embedded under the skin. Its diameter was $\cdot 17$ mm. and it was very thin-walled, so that the cercaria was easily liberated. Its resemblance to *Cryptocotyle concava* (Crepl.) is even at first sight very striking. The shape is flattened, considerably broader towards the posterior end than towards the anterior end. The length is $\cdot 48$ mm. and the breadth at the widest part $\cdot 22$ mm. The

Fig. 2.



Cercaria concava.

small round oral sucker has a diameter of $\cdot 06$ mm., the prepharynx is $\cdot 03$ mm. long, the pharynx $\cdot 04$ mm., and the œsophagus $\cdot 04$ mm. The diverticula have the shape characteristic of the adult *Cryptocotyle*, bending in towards the middle line in the vicinity of the genital sucker, then curving out, and finally turning in at their termination to approach each other. The excretory vesicle is clearly seen and consists of two fairly straight lateral tubes, beginning near the prepharynx and running into a simple, rather wide terminal sac at the posterior end of the body. The genital sucker is quite distinct, situated about the middle of the body. That this structure is not a ventral sucker in the true sense

of the term is evidenced by the fact that although the aperture is sharply enough defined, the sucker itself does not have the well-marked outline usually associated with the ventral sucker. Furthermore, the vestigial ventral sucker can be made out a little in front of the genital aperture, but its aperture is concealed in the genital sucker. Traces of two small testes can be detected in front of the ends of the intestinal diverticula, but none of the other organs are visible. The cuticle, as in the adult, is set with numerous regular scale-like spines.

This larval form appears to have hitherto escaped observation. Its identification as the cercaria of *Cryptocotyle concava* (Crepl.) seems quite justifiable without further proof, for it possesses the characters of that species in a marked degree and there is no other British species with which it is likely to be confused. We have found, too, that *Phalacrocorax graculus* (the slag), which is one of the hosts of the adult parasite (so far, the only British host), feeds largely on small plaice, dabs, and flounders.

Stephanochasmus baccatus, Nicoll. (Cercaria.)

We have to record this larva from *Pleuronectes limanda*. Only one cyst was obtained, but no special search was made for more; its frequent occurrence in young Pleuronectids has already been fairly well established. The cyst was embedded under the skin and its wall was very thin and membranous, the thick outer covering, mentioned by Miss Lebour*, having probably been removed in freeing the cyst from the tissues of its host. Its diameter was about $\cdot 7$ mm., but it was more or less ovoid, according to the movements of the enclosed cercaria.

The length of the cercaria is 1.8–2.0 mm. and in structure it agrees very well with the adult *Stephanochasmus baccatus*. Anteriorly it is covered with numerous regularly arranged spines, which disappear a short distance behind the ventral sucker. The oral sucker is encircled by two rows of larger and stouter spines which are closely applied to the aperture. They number 28 in each row and are regularly and symmetrically arranged, no gap being left in either of the rows. Those of the anterior row measure $\cdot 036$ mm. in length, in the posterior row $\cdot 04$ mm. on an average. There is slight variation in length.

The oral sucker is terminal and measures $\cdot 186$ mm. in diameter; the ventral sucker lies near the middle of the

* *Op. cit.* p. 14.

body and measures $\cdot 194$ mm. The suckers are thus nearly equal, although in the adult the ventral sucker is considerably larger than the oral sucker. The greater relative increase of the ventral sucker, however, is of almost invariable occurrence amongst Distomids.

The internal anatomy conforms very well to the *Stephanochasmus* type. The pear-shaped pharynx measures $\cdot 14 \times \cdot 09$ mm.; the prepharynx is twice as long and the œsophagus half as long. The excretory vesicle, as commonly occurs in encysted cercariæ, is of disproportionately large size. The testes are rather near the posterior end and the ovary is a little in front of them. The cirrus-pouch is well formed and extends to midway between the ventral sucker and the ovary. The yolk-glands were not very distinct.

The identification of larval *Stephanochasmus* species would appear to rest very largely on the number and relative length of the cephalic spines. Other features which aid in identifying adult species, such as the size of the suckers, the length of the cirrus-pouch, and the extent of the yolk-glands, are of very doubtful value in the case of cercariæ. The yolk-glands are not, as a rule, conspicuous enough, while the great increase in the length of the post-acetabular relatively to the pre-acetabular region as the genital glands develop and the cercaria attains maturity renders futile any differentiation based on the comparative sizes of the suckers or the proportionate length of the cirrus-pouch. Assuming, however, that the number of cephalic spines is constant, or very nearly so, in each species, it is obvious that this would provide a fairly reliable test in diagnosing species, except such as possess a nearly equal number of spines.

Of the known species of *Stephanochasmus*, *St. cesticillus* (Molin), *St. bicoronatus* (Stoss.), *St. pristis* (Deslongch.), *St. minutus*, Lss., and *St. rhombispinosus*, Lebour, have all less than 40 cephalic spines. In *St. caducus*, Lss., there are 48, in *St. trigla*, Lebour, about 50 (?), and in *St. baccatus*, Nicoll, 56. It seems hardly likely that the cercariæ of *St. caducus* and *St. baccatus* could be confused, for not only is there a difference of 8 spines, but the anterior row contains the longer spines in *St. caducus*, while the reverse is the case in *St. baccatus*. At the same time it must not be forgotten that it is often a matter of great difficulty to determine the length of the spines accurately, for owing to the curvature of the surface on which they are set they are usually seen somewhat foreshortened, and this applies more particularly to the spines of the anterior row. Between *St. trigla* and *St. baccatus* there is greater difficulty in

deciding. In Miss Lebour's description * of *St. triglae* the number of spines is given as lying between 42 and 56, and the spines of the anterior row are slightly longer than those of the posterior row. From a specimen of what is apparently *St. triglae* obtained at St. Andrews in *Cottus scorpius* we find that the number of spines is 50 and that the posterior spines are slightly longer than the anterior. In this specimen it was noticed that the spines of the posterior row had a tendency to diverge symmetrically from the middle line instead of being directed straight backwards, as is usually the case, but this may have been merely accidental. If the number 50 is confirmed for *St. triglae* it will obviously be easier to differentiate its cercaria from that of *St. baccatus* than from that of *St. caducus*.

The occurrence of *Stephanochasmus* cercariae encysted in various Pleuronectid fishes has already been described by Johnstone † from *Pleuronectes limanda* (recorded as *Distomum valdeinflatum*, Stoss.) and Miss Lebour ‡ from *Pl. limanda*, *Pl. microcephalus*, *Pl. cynoglossus*, and *Drepanopsetta platessoides*. As Johnstone makes no mention of the number or size of the cephalic spines it is impossible to be sure about the identity of the cercariae which he found. In Miss Lebour's specimens the number of spines varied from 48 to 58. From these observations two alternative conclusions may be drawn, either that the number of spines may vary within such wide limits in the same species or that Miss Lebour's collection included cercariae belonging to more than one species. The former is opposed to most observed facts; the latter seems much more likely. It is not at all improbable that the cercariae of *St. caducus*, *St. triglae*, and *St. baccatus* are all to be found encysted in young Pleuronectid fishes.

XXVIII.—*New Species of Dendromus and Tatera.*

By R. C. WROUGHTON.

IN a small collection of mammals made by Dr. Jameson in the Transvaal I found some specimens of a *Dendromus* which seems to require a new name; and, further, in comparing

* Northumberland Sea Fisheries Rept. for 1907, p. 27, pl. iii. figs. 3, 4.

† Rep. Lancashire Sea Fish. Investig. 1904, p. 98.

‡ Trans. Nat. Hist. Soc. Northumberland, New Series, ii. part i. p. 14, and Northumberland Sea Fish. Rep. for 1907. p. 28.